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Case Report

Endodontic Management of Radix Paramolaris in Permanent Mandibular Second Molars- A Case Series and Review

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Abstract

Mandibular second molars comparatively show a large number of variations in the root canal configuration, but exhibit fewer incidences of extra roots than mandibular first molars. They usually have two roots and seldom show additional root or root canals. When an extra root is present lingually or buccally, it is termed as 'Radix entomolaris' (RE) and 'Radix paramolaris' (RP) respectively. However, when such anomalies occur they need to be identified by multi-angulated radiographs and require a modification in access cavity preparation, cleaning, shaping and obturation technique. This article unveils the review of RP and strategic endodontic management of three cases of mandibular second molars with RP.

Keywords: Anatomical Variation; Mandibular Second Molar; Radix Entomolaris; Radix Paramolaris.

Abbreviations

RE: Radix Entomolaris; RP: Radix Paramolaris; 2D: 2 Dimensional; 3D: 3 Dimensional; IOPA: Intra oral periapical; SLOB: Same-Lingual-Opposite-Buccal; CBCT: Cone-beam computed tomography

Introduction

The ultimate objective of endodontic treatment is to preserve the tooth in the oral cavity and prevent the recurrence or treat the existing apical periodontitis. This can be achieved by access cavity preparation, thorough chemo-mechanical cleaning, shaping and three dimensional (3D) obturation of the root canal system. Knowledge of root canal anatomy of teeth, their variations, developmental dental anomalies and their management is imperative for successful endodontic therapy. Diversions in the root canal anatomy may occur in the form of additional roots, additional canals, different root canal configuration or apical deltas etc. which may require special attention, correct identification and modification of technique that may differ from routine endodontic cases.

Presence of an additional root is a relatively common variation in the permanent mandibular first molar. An extra root in mandibular molars was first identified by Carabelli in 1844, which was referred to as Radix Entomolaris (RE) and was observed distolingually [1]. Bolk identified an additional root located mesiobuccally and referred to it as Radix Paramolaris (RP) [2]. The presence of RE is a consistent finding in certain ethnic groups. The African population showed a prevalence of RE up to 3%, whereas the Eurasian and Indian populations showed a maximum of 5% of its occurrence [3]. The populations with Mongoloid traits i.e., Chinese, Eskimo and American Indians, show a wider range with 5% to 30% frequency [4-6]. The occurrence of RP is lesser than RE. A study conducted on mandibular molars showed that the occurrence of RP in 0.5% second molars, 2% in third molars and no evidence of RP in first molars [7].

It is crucial to identify the presence of an additional root before initiating endodontic treatment of any tooth. The intra-oral periapical (IOPA) radiograph is 2-dimensional (2D) representation of a 3-dimensional (3D) object. The orthoradiale projection (x-rays at perpendicular to the sensor or the film) may not reveal overlapped roots or root canals. Thus, it requires mesial eccentric and distal eccentric views (20-30 degree angulation), and the application of Clark's SLOB (Same-Lingual-Opposite-Buccal) rule,

to correctly identify the presence of extra roots or root canals. Advanced imaging such as; Cone-beam computed tomography (CBCT) is a breakthrough for precise identification of the root canal anatomy in such variations. However, the risk of additional exposure to radiation and cost-effectiveness must be considered before advising the CBCT scan to the patients. The current article enlightens a review on radix paramolaris with a case series of endodontic management of permanent mandibular second molars with RP.

Case 1

A 20-year old healthy female patient reported to the Department of Conservative Dentistry and Endodontics, with pain in tooth #47 since 2-3 weeks. Clinical examination showed deep occlusal caries in tooth #47. An IOPA radiograph revealed an extra mesial root in tooth #47 (Figure 1). Electric pulp test showed delayed response in tooth #47 and diagnosed as symptomatic irreversible pulpitis. Root canal treatment was advised in tooth #47 after obtaining the informed consent of the patient.

Figure 1: Pre-operative IOPA radiograph of tooth #47 showing additional mesio- buccal root.

Local anaesthesia was administered and the tooth was isolated under a rubber dam. The access cavity was prepared under 3.5x magnification loupes to explore the additional canal. After primary access cavity preparation, one distal and two mesial canal orifices were located with a DG-16 explorer (Dentsply, UK). The mesiobuccal canal orifice was eccentric and buccally directed; therefore, the conventional triangular access was modified and extended buccally. The canals were negotiated with No.#10 and No.#15 K-files (Mani Inc., Japan) and canal orifices were enlarged with Protaper SX gold rotary file (Dentsply, Maillefer). Working length was determined with a radiograph (Figure 2) and confirmed with an apex locator (Root ZX, J Morita, Tokyo, Japan). The root canals were cleaned and shaped with Protaper gold rotary files (Dentsply, Maillefer). The canals were sequentially irrigated with 3% sodium hypochlorite (Prime Dental, India), 17% ethylene-diamine-tetra-acetic acid (EDTA) and normal saline. The sodium hypochlorite was agitated with Endoactivator agitation tip (Dentsply Tulsa, Dental Specialities). IOPA radiograph was taken to confirm the apical extension of gutta-percha master cones (Dentsply, Maillefer) (Figure 3). Finally, the canals were dried with absorbent paper points (Dentsply) and coated with AH Plus (Dentsply, International Inc.) resin sealer followed by warm vertical compaction of the gutta-percha. The access cavity was restored with Cavit G (3M ESPE AG Seefeld, Germany) temporary restorative material. A postoperative radiograph of tooth #47 was taken and the patient was scheduled for permanent restoration

Figure 2: Working length IOPA radiograph of tooth #47.

Figure 3: Master cone IOPA radiograph of tooth #47.

Figure 4: Post-operative IOPA radiograph of tooth #47.

Case 2

A 28-year healthy female patient was referred from a private dental clinic to the Department of Conservative Dentistry and Endodontics with pain in tooth #37 since a week. The patient gave a history of incomplete root canal treatment for tooth #37, three

days back but did not have any relief. IOPA radiograph of tooth #37 taken by the previous dentist showed unusual root anatomy of mesial and distal roots giving suspicion of additional mesial and distal roots with root canals (Figure 5). Informed consent was obtained from the patient and the continuation of the endodontic treatment in tooth #37 was advised.

Figure 5: Pre-operative IOPA radiograph of tooth #37.

The tooth #37 was isolated under a rubber dam after securing local anaesthesia. Clinical examination showed the opened access cavity with three apparent root canal orifices mesiobuccal, mesiolingual and a distal. To locate the additional distal canal, the access preparation was modified with a Gates Glidden drill (Mani Inc., Japan) and the canal was scouted under 3.5X magnification loupes. Patency filing with No. #10-K file (Mani Inc., Japan) revealed a bifurcated distal root in the middle third. Working length was measured using apex locator and confirmed with IOPA radiograph in tooth #37 (Figure 6). IOPA also revealed radix paramolaris with bifurcated distal root in tooth #37. Zone technique of canal preparation was used in the distal canal. Accordingly, the distal canal was prepared stepwise in coronal and apical zones. Master cone IOPA radiograph was taken of tooth #37 (Figure 7). The canal preparation was carried out following the standard protocols and the root canals were obturated with AH Plus sealer and gutta-percha, with warm vertical compaction technique. The access cavity was restored with Cavit G (3M ESPE AG Seefeld, Germany) temporary restorative material and a postoperative radiograph was taken in tooth #37 (Figure 8). The patient was recalled for a permanent restoration.

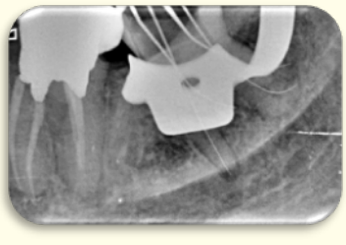

Figure 6: Working length IOPA radiograph of tooth #37.

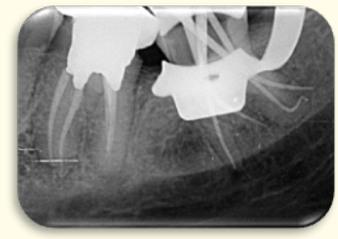

Figure 7: Master cone IOPA radiograph of tooth #37.

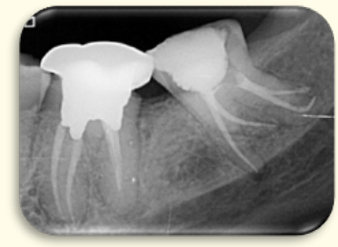

Figure 8: Post-operative IOPA radiograph of tooth #37.

Case 3

A healthy 20-year old female patient was referred by a private practitioner, with suspicion of an additional root on mesial side. The IOPA radiograph taken by the previous dentist suggested the presence of RP with tooth #47 (Figure 9). After obtaining the informed consent from the patient, root canal treatment was completed with tooth #47 by following the same standard treatment protocol of taking radiographic working length determination and confirming with apex locator, master cone IOPA radiograph and obturation with thermoplasticized gutta-percha (Figure 10-12).

Figure 9: Pre-operative IOPA radiograph of tooth #47.

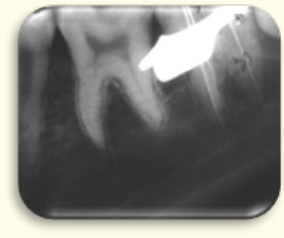

Figure 10: Working length IOPA radiograph of tooth #47.

Figure 11: Master cone IOPA radiograph of tooth #47.

Figure 12: Post-operative IOPA radiograph of tooth #47.

Discussion

Endodontic treatment aims at preserving the tooth in the oral cavity to its function, preventing reinfection and to treat the existing apical pathology. Knowledge and understanding of the tooth morphology, root canal anatomy and its variations, contribute to successful endodontic treatment outcome. The presence of unusual anatomy or anomalies in the teeth may complicate their endodontic treatment.

Mandibular first molars are the first permanent teeth to erupt in the oral cavity and play a vital role in mastication, the establishment of the arch perimeter, development of occlusion, maintaining the position of the tongue and cheeks etc. A major variant observed in mandibular first molars is an additional root present either buccally or lingually whereas; it is an uncommon finding in mandibular second molars.

According to Vertucci, the mandibular second molars are similar to the first molars, but have shorter roots, curved canals and have different anatomical configurations [7-9]. Mandibular second molars usually have two roots, the mesial and the distal, which may be separated or fused to form a single conical root. Their root canal anatomy may vary from a single canal to two, three or multiple canals, C-shaped canal or taurodontism.

Different theories have been put forth revealing the origin of RP such as, external factors during tooth development, penetration of an atavistic gene or due to genetic transfer as a dominant trait [10]. Studies conducted by Yew in 1993 [11] and Steelman in 1986 have also shown a 50% to 67% chance of bilateral appearance of the radix [12].

There is only one classification for the RP given by Carlsen and Alexandersen: [13]

- **Type A:** Cervical part of the radix is located on the mesial root complex;
- **Type B:** Cervical part is located centrally between the mesial and distal root complexes.

Various classifications have been given in the literature for RE based on the localization of the cervical part by Carlsen and Alexandersen [14], based on the curvature of the RE in a buccolingual plane by De Moor., *et al*. [15]. Song., *et al.* have given the classification based on computed tomography scans [16].

Multi-angulated intraoral radiographs play a pivotal role in the identification and diagnosis of such anatomical variations in the tooth. Wang., et al. suggested that mesial projections with 25-degree horizontal angulation is better for identification of RE [20]. Similarly, a careful examination of clinical crown exhibiting an extra cusp or the prominence of the disto-occlusal or distolingual lobe may also indicate the presence of an extra root [18]. Though, CBCT is considered as an advanced tool in dental diagnosis, in day to day practice in underdeveloped or developing countries; its cost, patient acceptance and increased patient radiation exposure are the factors of major concern for its limited use.

To manage severe root curvature, a Zone technique was employed in the present cases. In this technique, the root was divided into a coronal and apical zone, above and below the curvature respectively. After coronal pre-flaring with the crown-down method, the apical zone was shaped with the step-back technique, which avoids excessive stress on the rotary instrument and prevents apical extrusion of debris.

Clinical implications of RP

Endodontic consideration

Correct initial diagnosis of RP could avoid missed canals and future endodontic failure. Various guidelines could be used to locate canal orifice such as the use of endodontic explorer or micro-openers, tracking the dentinal map, champagne bubble test, use of dyes, transillumination as well as magnification. To locate and clean the additional canal the conventional access has to be modified from triangular to trapezoidal or rectangular outline. During access modification law of symmetry of orifice location must always be followed to locate the canal orifice. According to Yu., *et al.* there may be more iatrogenic errors such as instrument separation, lateral perforation, missed and underfilled canals in cases with presence of RE than in routine cases of mandibular first molars [19,20].

Periodontal consideration

Presence of RE or RP is associated with an additional groove in the root which may contribute to the formation of unfavourable bony defect leading to loss of attachment.23 When such teeth with Endodontic-periodontal involvement requires hemisection or root resection, the position and curvature of the extra root may exhibit a procedural challenge.

Extraction consideration

In RE or RP, the additional root is usually smaller or severely curved than the others. Thus, in the extraction of such tooth, it must be optimally luxated to avoid fracture of an extra root.

Orthodontic consideration

Presence of extra root and its curvature hinders the desirable orthodontic movement. Initial diagnosis of RE or RP is of prime consideration to avoid delayed and unwanted tooth movement.

Conclusion

Radix paramolaris is developmental anomaly occurred commonly in the mandibular molars. To perform endodontic treatment in such teeth require the knowledge of dental anatomy and associated variations with radiographic evaluation. In general dental practice in underdeveloped or developing countries like India, intraoral radiographs are the common and preferable mode of diagnosing the tooth anatomy and variations due to its easy availability, patient's acceptance and the low cost. Multiangualted intraoral radiographs reveal the presence of the anatomic variations to a great extent and help the general practitioner to adopt the necessary modifications during the endodontic procedure.

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